RCS 205
Operating Systems

Lecture3:

Components and Services

Lecture 3:

- Scope:
  - Operating System Components.
  - Operating System Services.
- Goals:
  - Understand the different components of a modern operating system.
  - Examine the different services provided by the operating system.

Introduction:

- An operating system provides the environment within which programs are executed.
- Internally, operating systems vary greatly in their makeup, being organized along many different lines:
  - Components.
  - Services.
  - Structure.

Operating System Components

Operating System Components:

- Not all systems have the same structure.
- However, most modern operating systems are made of the following eight components:

Operating System Components:

1. Process Management:

- A ***process*** is a program in execution.
- A program does nothing unless its instructions are executed by a CPU.

Operating System Components:

- A process needs certain resources to accomplish its task:
  - CPU time.
  - Memory.
  - Files.
  - I/O devices.
- A process is a unit of work in a system.
- Such systems consist of a collection of processes – operating-system processes and user processes.

Operating System Components:

- The Operating system (process management component) is responsible for the following activities in connection with process management:
  - Creation and deletion of processes.
  - Suspension and resumption of processes.
  - Provision of mechanisms for process synchronization.
  - Provision of mechanisms for process communication.
  - Provision of mechanisms for deadlock handling.

Operating System Components:

2. Main-memory Management:

- For a program to execute, it must be mapped to absolute addresses and loaded into memory.
- As the program executes, it accesses program instructions and data from memory.
- Eventually the program terminates – its memory space is declared available and the next program can be loaded and executed.

Operating System Components:

- The operating system is responsible for the following activities in connection with memory management:
  - Keep track of which parts of memory are currently being used and by whom.
  - Decide which processes are to be loaded into memory when space becomes available.
  - Allocate and de-allocate memory space as needed.

Operating System Components:

3. File Management:

- File management is one of the most visible components of an operating system.
- A file is a collection of related information defined by its creator.
- Commonly, files represent programs and data.
- The operating system implements the abstract concept of a file by managing mass storage media, and the devices which control them.

Operating System Components:

- The operating system is responsible for the following activities in connection with file management:
  - Creation and deletion of files.
  - Creation and deletion of directories.
  - The support of primitives for manipulating files and directories.
  - The mapping of files onto secondary storage.
  - The backup of files on stable (nonvolatile) storage media.

Operating System Components:

4. I/O system management:

- One of the purposes of an operating system is to hide the peculiarities of specific hardware devices from the user.
- For example; in UNIX, the peculiarities of I/O devices are hidden from the bulk of the operating system itself by the ***I/O subsystem***.

Operating System Components:

- The I/O subsystem consists of:
  - A memory management component – including buffering, caching, and spooling.
  - A general device-driver interface.
  - Drivers for specific hardware devices.
- Only the device driver knows the peculiarities of the specific device to which it is assigned.

Operating System Components:

5. Secondary-Storage Management:

- Since the computer's main memory is small and volatile, the computer system must provide secondary storage to back up main memory.
- Most modern computers use disks for secondary storage.
- Thus, the proper management of disk storage is of central importance to a computer system.

Operating System Components:

5. Secondary-Storage Management:

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Operating system components:

- The operating system is responsible for the following activities in connection with disk management:
  - Free-space management.
  - Storage management.
  - Disk scheduling.

Operating system components:

6. Networking:

- A *distributed system* is a collection of processors that do not share memoperipheral devices, ry, or a clock.
- The processors in the system are connected through a communication network.
- Operating systems usually generalize network access as a form of file access, with the details of networking being contained in the network interface's device driver.

Operating system components:

7. Protection system:

- If a computer system has multiple users and allows the concurrent execution of multiple processes, then the various processes must be protected from one another's activities.
- Mechanisms are provided to ensure that the files, memory segments, CPU, and other resources can be operated on by only those processes that have gained proper authorization from the operating system.
  - Memory addressing hardware.
  - Timers.
  - Device control registers.

Operating system components:

- Protection refers to *a mechanism for controlling the access of programs, processes, or users to the resources defined by a computer system*.
- This mechanism must provide a means for specification of the controls to be imposed, together with a means of enforcement.

Operating system Components:

8. Command-Interpreter system:

- The ***command interpreter*** is one of the most important system programs.
- It is the interface between the user and the operating system.
- Many commands are given to the operating system by ***control programs***.
- When a new job is started in a batch system, or a user logs on to a time-shared system, a program that reads and interprets control statements is executed automatically.
- Its function is simple: *get the next command statement and execute it*.

Operating System Services

Operating system services:

- An operating system provides an environment for the execution of programs.
- To achieve this, it provides certain services to programs and to the users of those programs.
- Services differ from system to system- however some are common.

Operating system services:

1. Program execution:

- The operating system provides the mechanisms for the loading and execution of programs.
  - The system must be able to load a program to memory and execute it.
- The OS also provides the means for process termination
  - program must be able to end its execution, either normally or abnormally.

Operating system services:

2. I/O operations:

- A running program may require to perform some I/O operations.
- For efficiency and protection, users usually cannot control I/O devices directly.
- The OS must provide some means to do I/O.
  - A program should be able to read and write to any input/output device by use of the interface provided by the operating system.

Operating system services:

3. File system manipulation:

- Programs store their data in files, and also read file inputs.
- Programs also need to create and delete files by name.
- The OS must provide the mechanisms necessary for programs that need to read and write files.
- It should also provide the means for file creation and deletion.

Operating system services:

4. Communication:

- In certain circumstances, a processes need to exchange some information with other processes.
- The operating systems provides the necessary inter-process communication (IPC) mechanisms.
- Two common approaches:
  - Shared memory.
  - Message passing.

Operating system services:

5. Error detection:

- Errors may occur in the system during program execution.
- The operating system constantly needs to be aware of possible errors.
- For each type of error, the operating system should take the appropriate action to ensure correct and consistent computing.

Operating system services:

Other Services:

- Other operating system functions exist to ensure the efficient operation of the system itself. They include:

6. Resource allocation.
7. Accounting.
8. Protection.